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**Electroset Technology: On the Forefront  
of Manufacturing**

by

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A newly patented technology is emerging which will help American manufacturers produce goods faster and more affordably. Additionally, manufacturers can use it to diversify their product lines by making complex parts quickly and efficiently. Its called Electroset Technology (EST).

In order to see that advantages of EST, let us first look at conventional technology and then see how EST differs from it.

**Conventional Technology**

Consider a two-part epoxy that you might purchase at a local hardware store. After mixing part A with part B and then pouring it into a mold, the mixture hardens into an object. The rate at which the hardening takes place is determined by the constituents of the mix. The end-product properties of that molded object (e.g. density, compressibility, hardness, etc.) are determined by the initial constituents that went into the mix. If you wish to change the cure rate (e.g. the rate a which the mix hardens), or if you wish to change an end-product property such as density or compressibility, etc., then you will have to change the initial constituents of the mix.

**Electroset Technology (EST)**

With EST, standard casting resins are modified to be electrically semiconductive while they are in their fluid state. Electroset resins are electrically polarizable particles immersed within and suspended throughout casting resins. Because they are semiconductive in their fluid state, electric energy can be applied to and through these resins during cure to do useful work. Electroset processing of materials:

- a.) electrically accelerates the cure of objects/materials;
- b.) provides the means to electrically program into objects (during cure) the properties that the final cured product has. Such properties include density, compressibility, hardness, surface roughness and other material properties;
- c.) allows the manufacturer to select whether the programmed object will have anisotropic properties or else have homogeneous

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properties; and

d.) enables complex objects to be formed simplified molds.

### Advantages of Electroset Technology

When thermosetting resins are modified and made into electroset resins, the cure of the can be electrically controlled and electrically accelerated. This is useful because polymers are typically not good thermal conductors. Without electroset technology, it is difficult to get heat energy into the resins to accelerate the cure.

Some resins can be electrically foamed without the use of CFCs or HCFCs. The process of foaming works like this:

1. Electric energy is applied to and heats up the casting resin.
2. At a critical temperature, a constituent (e.g. a foaming agent) of the resin undergoes phase change from fluid to gas, thereby creating bubbles in the resin.
3. As the bubbles form and expand, the rest of the resin solidifies around the bubbles, thereby making the foamed object or material.

One benefit of electroset foaming is that we can choose to use foaming agents other than CFCs and HCFCs which are harmful to the environment. However, a greater advantage is that we can use one formulation of casting resin and merely program into it different amounts of foaming. The technology enables the manufacturer to, at the flick of a switch or a turn of a knob, control how much foaming (and thus density) that the end-product will have.

### About Foams

#### Conventional Foams

Conventional molded foams usually have a foaming agent as one of the constituents. Heat is required in order to cause the foaming agent to change from a fluid to a gas. But polymers are not good thermal conductors so it is difficult to get the heat into them in order to make the foam. With conventional technology exothermic chemical reactions are relied upon to heat up the material and create the foam. However, the higher the exothermic heating required, the higher the molecular weight that the constituents must have. The higher the molecular weight, the higher in viscosity are the constituents. High viscosity constituents are difficult to mix and pour into a mold. They are not user friendly.

#### Electroset Foams

Electroset foams, however, do not have these limitations. Because the heat energy is electrically supplied from an external source, the need for exothermic chemical reactions is greatly

reduced. This means that resins can be foamed that have low initial viscosities, which are easier to mix and pour. They are much more user friendly.

#### Potential Applications

Electroset technology can be used to electrically accelerate the cure of composites, thus increasing the production capacity (e.g. decreasing the production time) of autoclave cured composite materials.

Electroset foams can be used to make objects that complex density designs such as shoe soles which have different regions of compressibility. The technology has an abundance of potential commercial applications. If you are interested in finding out more about Electroset Technology, please call or write:

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Commercial applications of Electroset Technology are available for license from the U.S. Government.

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## ELECTROSET TECHNOLOGY

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### Improved handling of thermoset molding resins

#### conventional technology

##### exothermic cure requires:

- over curing, or
- high viscosity, hard to mix compounds which use exothermic chemical reactions the higher the heat needed, the higher the molecular wgt. But, the higher the molecular wgt., the higher the initial viscosity of the resin
- Change the chemistry in order to change the end-product properties

#### electroset technology

##### electric cure enables:

- inexpensive electrode curing
- low initial viscosity resins (easy pour)
- particles within the resin help to mix the compound during cure
- change of voltage/current causes change in end-product properties

## Advantages of Electroset Technology

- Faster production (curing) of molded parts/materials
- Increases flexibility in manufacture:
  - fast changeover of materials manufacture
  - improves handling of molding resins
- Increases diversity of fabricated parts/materials
- Environmentally friendlier manufacturing
- Simplifies molding of complex objects/materials
- Lowers business costs

## PROCESSING ELECTROSET MATERIALS

- Electrically accelerates the cure of the object/material
- Electrically program into the object during cure the end-product (cured) properties you want the object to have. Such properties include:
  - density
  - compressibility
  - hardness
  - surface roughness
  - adhesion
  - bouyancy
- Select whether the object will have homogeneous or anisotropic properties
- Use electric fields to shape complex objects from simplified molds